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NEW INSIGHTS INTO THE STRUCTURAL, HYDROTHERMAL, AND BIOLOGICAL SYSTEMS OF LONG VALLEY CALDERA USING HYPERSPECTRAL IMAGING

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by

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Table of Contents

List of Figures

Chapter One:

Chapter Two:

Chapter Three:

List of Tables

Chapter One:

Chapter Two:

New Insights into the Structural, Hydrothermal, and Biological Systems of Long Valley Caldera Using Hyperspectral Imaging

Brigette A. Martini

Abstract

Long Valley is one of the better-studied calderas in the world, and is one of three active calderas in the contiguous United States. Suites of increasingly sophisticated geophysical and geochemical studies performed there since the late 1970's have revealed a restless and dynamic volcanic system. The years of study have elucidated much about the structure, tectonics, volcanogenesis, and hydrothermal system of Long Valley, but ambiguities still remain. The role of regional tectonics in the formation of Long Valley is unclear, geography of hydrothermal circulation and locations of major discharge zones are loosely determined, and biological systems in the caldera remain largely unstudied. In this thesis, I use hyperspectral imaging to study the Long Valley caldera. This synoptic, high spatial resolution remote sensing data is a new way of looking at active volcanoes; reproducing both previously known data and revealing new information.

In Chapters One and Two, I use 5 meter HyMap hyperspectral data to detect and map mineralization within Long Valley Caldera. Linear distributions of hydrothermal alteration mineral assemblages are proxies for zones of structural weakness with high permeability. Mineral maps with these linear distributions are presented as refined structural maps, where many distributions coincide with previously mapped

structures and some map new structures. The fine spectral sampling of hyperspectral data also allows for mineral identification, which aids in producing new maps of hydrothermal circulation patterns and gross geochemical zonation in the caldera.

Chapter Three uses hyperspectral imaging to study the volcano-associated biological systems of Long Valley. Boundaries and growth of volcanogenic CO_2-induced tree-kills are studied, geothermally induced artificial senescence is documented, and thermophilic microorganisms within hot spring ecosystems are detected and mapped. Chapter Four discusses the use of AVIRIS hyperspectral imagery for direct detection of anomalous volcanogenic CO_2 on Mammoth Mt.

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